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pleasure of listening to it. It was published in full in the issue of SCIENCE for January 19, 1906, and will be found on page 92. It was also published in the January issue of the *Stevens Institute Indicator* (Vol. XXIII., p. 7). The author quoted Mr. Walter C. Kerr, in connection with his work as trustee of Cornell University, as being in favor of the plan that a professor shall be thrown upon his own resources and be compelled to work in the practical field one year out of seven. It seems that the author was misinformed as to Mr. Kerr's real meaning, and that Mr. Kerr has called his attention to the matter in a letter which will be found in the April issue of the *Stevens Institute Indicator*. Mr. Kerr explains his ideas at some length, and includes a memorandum on the subject which he made to President Schurman. Eight other letters are included commending the substance of this address and pleading for the more intimate connection of engineering professors with actual practice.

It gives the secretary much pleasure to state that the Society for the Promotion of Engineering Education has decided to meet at Ithaca June 29 to July 3 as an 'affiliated society' of the American Association for the Advancement of Science. It is probable that one or more joint sessions will be held with Section D during the meeting. In view of this, the sectional committee has decided that there shall be a summer meeting of Section D. The members of the association are requested to submit their papers by abstract at as early a day as possible. Papers on the science of engineering education, its problems and its advances, and on municipal ownership from the engineering point of view, are especially requested.

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PANAMA: A DISCUSSION OF PRESENT
CONDITIONS AND THE PROSPECT.¹

WHEN a certain prominent member of the engineer corps returned to New York in the fall, after a year's residence at Panama, he declared the working force on the isthmus was badly demoralized on account of the defection of native labor, the resignation of John F. Wallace, the yellow-fever scares, and the excessive humidity, which decreases one's vital energy in the tropics fully fifty per cent. It is now about eight months, he said, since Wallace resigned, and the Shonts Commission, with Stevens as chief engineer, took hold of the work. In May, 1905, the yardage excavated had dropped to 70,000, as compared with 130,000 in April. The figures for June showed a further retrogression. Accordingly, by order of Chief Engineer Stevens, all work was stopped on the canal excavations, and the energies of the force were diverted to sanitative work—the building of houses for the men, cisterns and pipe-lines and reservoirs for drinking-water, sewers to drain a country which has been innocent of sewer-systems and plumbing for four centuries. This is the work which the distinguished engineer and canal commissioner, George S. Morison, said would have to be done in advance of canal excavation, and he allowed two years for it. Governor Magoon has built a reservoir twelve miles from Panama and installed a first-class system of water-works. Two thousand houses of the French have been repaired, new barracks built, and Dr. Gorgas has been doing a magnificent work in eradicating the breeding-places of the mosquito, and purging the whole region of the agglomerated filth of the Spanish occupation.

The necessary action of Chief Engineer

¹ Read at the New Orleans Meeting of the American Association for the Advancement of Science, Tuesday, January 2, 1906.

Stevens in postponing the excavatory work means that a lot of highly-paid specialists—transitmen, levelmen and others—have been practically without occupation, though still, of course, retained on the pay-roll. And of the fact that idleness, in a tropical country, breeds demoralization in a working force, the history of the Panama Canal affords numerous instances. One of the first acts of the new administration was to abolish the quartermaster's department under Capt. E. L. King, and turn over the matter of paying the laborers to the auditing department, who have handled it very badly. Frequently the laborers have been compelled to wait over two pay-days (more than a month), although they live on the credit system, and the Chinese storekeepers refuse to trust them beyond the first pay-day.

With the shut-down of the work on the Culebra cut, a great many of the men from the states were sent home, and consequently skilled artisans have been scarce. Carpenters have been in brisk demand, but it has been difficult to induce a sufficient number to remain upon the isthmus. In constructive work, the great difficulty (as under the Wallace administration) has been to secure supplies. The department of supplies under Paymaster E. C. Tobey, U.S.N., has always been a great stumbling-block to the progress of any work on the isthmus, and it was the inefficiency of this department, as much as anything else, that led to Mr. Wallace's throwing up his hands in despair. However, not all of the trouble has been on the isthmus. The Washington end of the department, under Colonel Edwards, of the Bureau of Insular Affairs of the War Department, is encumbered in its action by much red tape and meaningless routine procedure.

Engineer Stevens has earned for himself, we are told, the title of 'The Sphinx.' (If he has, it seems to us a creditable nickname,

in these days when public officers, as a rule, talk too much!) Stevens has discharged scores of men in an attempt to bring about changes for the better. There is much petty jealousy, which vents itself in factional rows. The men sent on by the civil service are far below the standard of the men chosen by selection under the Walker Commission. As a glaring instance might be cited the case of a high engineering official who has been sent to the isthmus at a high salary, after having been discharged by the Walker Commission of 1901-2 for gross inefficiency as a transitman. This criticism applies not only to the specialists and the technical men, but to the mechanics as well. There are 11,000 men on the roster building houses and doing sanitary work for the sanitary department. At the present rate of progress it will take more than a year—perhaps two years—before it will be possible to think of actual canal building. The purchase of a few new steam shovels does not mean very much under the circumstances. Everything drags along at a snail's pace. Mr. Shonts has told the advisory board that the excavation work could not be done at the figures obtained under the Wallace régime (650,000 cubic yards were taken out in the first year at less than fifty cents per yard). The present administration fixes a price of not less than eighty cents per yard.

At the Panama end, the engineer I have been quoting went on to say, work under Resident Engineer Harper is practically at a standstill, and has been very adversely affected by quarantine. At Culebra the engineer parties in the canal prism under Resident Engineer Nichols and the outside work under Ruggles have been accomplishing very little of interest, except some cross-section lines and some borings on the canal line. A gang of men are changing the railroad track from the high, narrow, Belgian rails to the heavier new rails. Prepa-

rations are being made to fill in the lock chamber excavated by the French at Obispo and start in with steam shovels. Track has been laid out from the main line of the Panama Railroad. All idea of double-tracking this road has been abandoned, and instead gangs of men are putting in sidings at all stations. Only fifteen trains a day now run, and the capacity of the single track ought to be three or four times as great as this, with proper handling. Lack of rolling-stock has been a serious drawback. The engineer party at Obispo has been cross-sectioning the tunnel-line to the Atlantic discovered by Engineer Boyd Ehle, but no further advantages have developed, and the net result has been more topography. In general, most of the late surveys have been entirely of a dilatory nature; presumably they have been made in order to keep the large surplus of engineers to some extent employed. Work at the Colon end, in default of proper facilities for unloading vessels, has been of no consequence, and there seems to be a doubt as to the best course to pursue. Division Engineer Moltkey wants to take ships up the canal to a place where there is about thirty feet of water and soft-mud bottom. In the meantime the shipping has to be handled as before.

According to this observer, the most difficult thing to realize on the isthmus is what the 11,000 men are doing; certainly it amounts to very little. Here and there groups of workmen can be seen puttering away, but at the end of a week or a month there is a very inconsiderable result to show for it, and taking the present rate of progress as a measure, it would seem as though the work might go on indefinitely. It is particularly disappointing to Americans to realize that the French must have made a much better showing when excavating 70,000,000 cubic yards and building

nearly 1,500 houses and quarters, in spite of great financial embarrassments. My informant is of the opinion that it has yet to be demonstrated that the Anglo-Saxon is better fitted for the task than the Latin, in spite of Chairman Shonts's excuses. It is a notable fact, he says, that men new to the tropics need from six months to a year to comprehend the combined effect of the inertia due to climate, the inefficiency of labor, and the paralysis of energy due to bureaucracy and red tape.

So much, then, for the statements of engineers who have recently returned from the isthmus. A certain allowance must be made for the personal equation. No one man—no group of men—can possibly know all that is to be known about the Panama Canal, and it is a common human tendency to criticize when one, perhaps, does not quite understand. None of us is quite free from this tendency. Let us turn, then, for a moment, from the criticism of labor conditions to a brief statement of actual accomplishment at the isthmus. In any difficult enterprise, when one gets discouraged at what has yet to be done, it is heartening to pause a minute and consider what has, after all and in spite of all, *been done*.

The total yardage excavated on the Panama Canal to date is about eighty million cubic yards. The yardage that directly applies along the canal route as finally determined is about forty-one millions. On the eighty-foot level plan, this means that about 28 per cent. of the big ditch has been dug; on the sixty-foot level plan, about 23 per cent.; on the thirty-foot level plan, about 19 per cent.; on the sea-level plan, about 16 per cent. In the roundest kind of round numbers, this leaves about 185,000,000 yards still to be excavated for a sea-level canal; 140,000,000 for the thirty-foot level; 110,000,000 for the

sixty-foot level. The time required, according to John F. Wallace, is twelve, ten and eight years, respectively. The cost would be: sea-level, \$230,475,725; thirty-foot level, \$194,213,406; sixty-foot level, \$178,013,406. The yardage cost, 54.7 cents, is based on the following figures: Installation of plant, 1.5 cents; mining, 11.2 cents; loading material, 11 cents; transportation to dumps, 11.5 cents; dumps, 4.5 cents; maintenance of track, 8.4 cents; general expense, 6.6 cents. From May 1, 1904, to May 1, 1905, about 650,000 cubic yards were excavated. The United States assumed control May 24, 1904, so these figures practically represent what was accomplished during the first year of American occupation.

The enemies of the canal project are legion, and to the friends of the inter-oceanic waterway—which has now become an accepted fact—the description I have just quoted of the conditions that obtain at Panama seems like a jeremiad of the kind the congressional obstructionists delight in. But he who reads between the lines will not find in the generally trustworthy and unbiased account of the engineer referred to any particular reason to be discouraged about the canal. What it all means is simply this: That on the first of July, 1903, the United States lost the greatest civil engineer our country has ever produced—George Shattuck Morison, a man who spared no effort to find out the facts about isthmian canalization, and then to lay these facts before the people in plain language. Somewhere still in the ‘sounding laborhouse vast,’ that ‘immense and brooding spirit’ must be observing, with something of his old, fine indignation, the frenzied haste with which men and supplies have of late been rushed to the isthmus, ere any adequate provision has been made to keep men well, and house them near their

work. For instance, a party of engineers, whose work has been of the greatest importance in determining the feasibility of the Gamboa dam—the only alternative for the practically discarded Bohio project—had to wait six weeks to get their transits and levels from the government storehouse. Personal appeal and written protest alike were unavailing. For another party, mosquito-bars were needed. No attention was paid to a requisition, and finally the chief of party stole them.

Mr. Morison, who saw things in a big, broad way, realized that when once the Americans took over the control of the canal zone, they would, with characteristic American impetuosity, be in altogether too much of a hurry to ‘make the dirt fly,’ adopting the popular slogan. In his numerous addresses delivered before scientific societies—in statements made at hearings before congressional committees—in short, at every public or private opportunity, in season or out of season—Mr. Morison deprecated haste. He insisted that we must take two years to clean up the mess made by the Spaniards and the French—to burn the hovels, to drain the swamps, to petrolize the breeding-places of the mosquito, to build clean, wholesome houses for the men. He went down there himself and put his fingers into the dry-rot, and found there the seeds of his own mortal illness. Whitewash could not fool him, whether it covered the walls of a pesthouse or whether it concealed some mishandling of canal affairs. A great many men, since Mr. Morison died, have paid tribute to his absolute honesty, and his passion for exact statement based on accurate observation. Had Morison lived, he might have been able to check the tendency to ‘hustle,’ in the scrambling ambition to make dirt fly simply that the foolable part of our country’s population might be deceived by a specious appearance of ‘some-

thing doing.' All calamity-howlers to the contrary notwithstanding, the canal is as sure to be built as a natural law is certain of fulfilment; and those who to-day busy themselves trying to find arguments against it are going to be ashamed and sorry when the seas are eventually linked by the greatest engineering undertaking in the history of mankind. For a canal which saves nine thousand miles of ocean journey between San Francisco and New Orleans, six thousand miles between Yokohama and New Orleans, two thousand miles between Hong Kong and New Orleans and six thousand miles between Sydney and New Orleans, is an agency in bringing mankind nearer to mankind too vastly important to evade the sight of God and escape the desire of nations. But just now, rather than any statement of cubic yards excavated in August or September or October, one finds the following figures significant:

In June, 1905, there were 62 cases of yellow fever on the isthmus; in July, 42; in August, 27; in September, 6; in October, 3. In August, 1905, with a force of 12,000 men at work, the death-rate was two thirds of one per 1,000, whereas under the French régime, in August, 1882, with a force of 1,900 men, the death-rate was no less than 112 per thousand. These figures will appeal to the citizens of a community whose recent fight against yellow fever has been the admiration of the civilized world and a great object-lesson to uncivilized humanity; an object-lesson in civic self-dependence, public spirit and uncommemorated heroism. A city that can pass through such an ordeal, a city that faces a great crisis as New Orleans faced the yellow-fever epidemic, is the surest guarantee that the nation of which that city is a part will do her duty by civilization, and build, expeditiously and economically, the Roosevelt Canal.

FULLERTON L. WALDO.

*THE MOVEMENT IN PRUSSIA FOR THE RE-
ORGANIZATION OF THE INSTRUCTION
IN MATHEMATICS AND THE NAT-
URAL SCIENCES IN THE SEC-
ONDARY SCHOOLS.*

FOR over a decade, there has been a noteworthy movement in Prussia aiming at the improvement of instruction in mathematics in the secondary schools.¹ The aim is not an increase of the amount of time given to mathematics, but a reorganization of the subject matter of the mathematical curriculum so as to bring it into closer conformity to the needs of the times, in particular by giving more attention to the applications of mathematics, and by laying less stress in the earlier years on those more abstract phases of the subject which overtax the pupils' powers at that time. The most prominent leader in the movement is Professor Klein, of Göttingen, whose views are most readily accessible to American readers in a recent book collecting various addresses and papers of his on the teaching of mathematics.² He is a pronounced advocate of the introduction of the elements of the differential and the integral calculus into the work in mathematics in the secondary schools of Prussia.

This agitation has borne fruit in the new Prussian curricula of 1901, wherein decidedly more stress than previously is laid on concrete beginnings, on graphic methods, on deferring the more abstract phases of the various subjects and on applications throughout to the affairs of practical life

¹This term is used as indicating the closest American equivalent. The German term is 'higher schools.' Pupils are admitted to the schools at the age of nine, the course of instruction covers nine years, and the normal age of graduation is nineteen or twenty. In mathematics the ground covered is approximately that of our grades, secondary schools and freshman year in college.

²F. Klein, 'Über eine zeitgemässe Umgestaltung des mathematischen Unterrichts an den höheren Schulen,' Leipzig, 1904, pp. ii + 82.